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Using practitioner knowledge to expand the toolbox for private lands conservation

Drew E. Bennett[a,*], Liba Pejchar[a], Beth Romero[a], Richard Knight[b], Joel Berger[a,c]

[a] Department of Fish, Wildlife, and Conservation Biology, Campus Delivery 1474, Colorado State University, Fort Collins, CO 80523, USA
[b] Department of Human Dimensions of Natural Resources, Colorado State University, Fort Collins, CO 80523, USA
[c] Wildlife Conservation Society, 212 South Wallace Ave, Suite 101, Bozeman, MT 59715, USA

ABSTRACT

Private lands provide important habitat for biodiversity and are critical to many conservation efforts. With increasing awareness of the importance of private lands, a broad suite of strategies to engage landowners in conservation is emerging. The success of these strategies is contingent on a skilled workforce of conservation practitioners that can scale-up these efforts and meet both ecological and livelihood objectives. Although professional capacity building is an acknowledged priority in the conservation community, the knowledge and experience of conservation practitioners (e.g., individuals working at land trusts and government agencies) has not been widely assessed. Here, we surveyed practitioners in the United States to gauge their familiarity with seven approaches to private lands conservation in different landscape contexts. Most practitioners were familiar with only two conservation tools, conservation easements and direct payment programs (e.g., Farm Bill programs), and familiarity varied among different types of organizations. Although these tools were perceived to restrict residential development and restore habitat, respectively, they had limited reported impact on climate change mitigation or relevance to urban areas. Widespread reliance on just two tools also raises important questions about the vulnerability of private lands conservation efforts to political and institutional changes and the ability to meet multiple conservation objectives in a world undergoing rapid climate and land use change. We argue for targeted efforts to enhance the professional capacity of conservation practitioners to expand the toolbox and achieve multiple conservation goals on diverse private lands.

1. Introduction

Global efforts to conserve biological diversity frequently target governance at national and international scales, yet vast tracts of biologically productive land remain in private or communal hands. This is particularly evident in the contiguous United States where roughly two thirds of the land area is privately owned. These private lands are under a range of human uses with varying compatibility with conservation objectives, yet they are essential for the survival of many species (Scott et al., 2001; Jenkins et al., 2015). Over 90% of species listed under the U.S. Endangered Species Act occur on private lands, and these lands provide > 60% of the habitat for two-thirds of listed species (US Government Accountability Office (USGAO), 1995). Many privately-owned lands are also under greater threat of habitat conversion as compared to public lands; a recent study estimated that roughly a hectare of natural land is lost every 5 min in the American West with three-fourths of losses occurring on private land (Center for American Progress (CAP), n.d.). Given that public protected areas alone are inadequate to conserve the full suite of biodiversity under global change (Scott et al., 2001; Jenkins et al., 2015), developing strategies to achieve conservation goals on working landscapes managed primarily for human benefit is a priority (Knight, 1999; Norton, 2000).

In the United States, conservation practitioners have relied on conservation easements as a key tool for private land conservation (Merenlender et al., 2004). While successful in restricting development and buffering public lands (Wallace et al., 2008; Pocewicz et al., 2011), conservation easements also have limitations (Merenlender et al., 2004). For instance, one study in Wyoming, USA, found little difference in land management practices or the presence of invasive species on properties with or without easements (Pocewicz et al., 2011). The majority of conservation easements in the United States are perpetual agreements and many landowners baulk at permanently restricting use of their property, limiting the utility of this tool to those landowners willing to accept permanent restrictions (Ando and Chen, 2011). Conservation easements are also typically static legal agreements, which could make adaptive management in response to climate change difficult (Rissman et al., 2015). Outcomes of conservation easements are also typically reported in terms of “acres and bucks” without meaningful regard to the ecological values of these lands, including ongoing stewardship (King and Fairfax, 2004; Kiesecker et al., 2007; Rissman et al., 2007; Rissman and Smail, 2015). Although there is certainly a need to improve understanding of the social and ecological outcomes of

* Corresponding author at: Ruckelshaus Institute, Haub School of Environment and Natural Resources, University of Wyoming, Laramie, WY 82072, USA.
E-mail addresses: drew.bennett@uwyo.edu (D.E. Bennett), liba.pejchar@colostate.edu (L. Pejchar), Richard.knight@colostate.edu (R. Knight), jberger@wcs.org (J. Berger).

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conservation easements, given their known limitations, building capacity for complementary or alternative tools is also desirable.

Achieving conservation goals on private lands in the United States and globally arguably requires a portfolio of conservation strategies beyond conservation easements (Doremus, 2003; Kamal et al., 2015) and a skilled workforce with the necessary knowledge and skills to implement these strategies. Although building professional capacity is a recognized priority in the conservation community (Rodriguez et al., 2006; Bruyere, 2015), it has not been broadly assessed. While there have been numerous studies documenting landowner knowledge and experiences with different conservation programs, we are unaware of comparable studies of the other professional groups responsible for implementing these strategies. For instance, no studies have evaluated the familiarity of these groups with a diverse portfolio of conservation tools, nor their perceptions of how effective these tools are in different contexts. This study addresses this gap through an online nation-wide survey of private lands conservation practitioners (i.e., professionals that work directly with private landowners or on privately owned lands to implement conservation projects and policies) in the United States. Our study was guided by the following specific research questions: 1) How familiar are conservation practitioners with various tools for private land conservation and does familiarity vary among practitioner groups? 2) How effective do conservation practitioners perceive each tool at addressing a range of conservation challenges in different landscape contexts? 3) What are the best pathways for engaging conservation practitioners and enhancing their professional capacity to conserve private lands?

2. Materials and methods

We conducted a national, online survey of conservation practitioners in the United States to understand their familiarity with, and experiential knowledge of, a suite of seven voluntary, incentive-based private lands conservation tools (Table 1). Although there were additional tools that could have been included (e.g., wetland banking), practical constraints on the time required to complete the survey limited the scope to the seven tools. We selected tools that we expected to have a range of familiarity to practitioners including both well-established (e.g., conservation easements) and relatively novel tools (e.g., pop-up habitats). Because the social and ecological outcomes for most of the conservation tools we included are virtually unknown, we examined practitioner perceptions to provide a baseline to guide more focused, field-based research on outcomes. Studies of perceptions and experiential knowledge have been used as one form of evidence to understand the social and ecological outcomes of conservation initiatives and to provide insights to improve national and international conservation policies (Bennett, 2016).

The population we aimed to study was conservation practitioners involved with voluntary biodiversity conservation activities primarily on private lands. We considered relevant conservation activities to include project implementation (e.g., conservation easements, restoration projects), consulting or advising services related to conservation, and providing conservation related outreach or trainings. Developing a robust sample of the study population presented several challenges, partially because many organizations are engaged in conservation activities on private lands at multiple scales (e.g., local, statewide, national). To capture this diversity, we aimed to have roughly equal representation in the sample among individuals currently employed by organizations in six categories: local non-governmental organizations (NGOs), state or regional NGOs, national or international NGOs, local governments, state government agencies, and federal agencies. To ensure diverse representation from different geographic regions in the United States, we used the nine divisions of the Bureau of Labor Statistics to guide our sample development. For each category (e.g., local NGOs), we randomly selected an organization located in each division and searched webpages and other online resources to identify email addresses of employees. We then analyzed employee titles and position descriptions to identify staff likely to be directly involved with conservation activities (e.g., project coordinator, conservation director). We excluded individuals with position titles and descriptions unlikely to be directly engaged in conservation (e.g., development officer, administrative assistant).

To develop the sample for NGOs, we included practitioners working for local and statewide land trusts and conservation organizations, organizations employing private lands or Farm Bill biologists (e.g., Ducks Unlimited), and national or international NGOs (e.g., The Nature Conservancy). We used the Land Trust Alliance's “Find a Land Trust” webpage to identify local and statewide conservation organizations (Land Trust Alliance (LTA), n.d.) and augmented this resource with additional organizations involved with private lands conservation activities (e.g., Pheasants Forever). For local governmental agencies, we used the membership directory of the National Association of County Park and Recreation Officials and the Trust for Public Land's LandVote Database to identify cities and counties with natural area, open space, or other relevant natural resource programs (National Association of County Park and Recreation Officials (NACPRO), n.d., Trust for Public Land (TPL), 2018). We then identified specific city and county positions likely to focus on conservation activities (e.g., conservation planner, director of natural resources). At the state level, we sampled individuals working for state wildlife and natural resource agencies while at the federal level we sampled staff from the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program and field staff with the Natural Resources Conservation Service involved with implementing biodiversity conservation projects. We excluded practitioners working in the private, for-profit sector (e.g., environmental consulting firms) due to the challenge of identifying relevant companies and individuals to

Table 1
Private lands conservation tools included in this study.

Conservation tool	Definition	Example citations
Conservation easements	A voluntary and legally binding agreement between a landowner and a conservation organization or government agency that limits uses of the land to achieve conservation goals.	Merenlender et al., 2004, Byers and Marchetti Ponte, 2005
Direct payment programs	A tool in which a cash payment or other incentive is provided to landowners in exchange for a conservation outcome or land-use practice likely to produce an outcome.	Ferraro and Kiss, 2002, Clements et al., 2013
Conservation developments	Projects that combine residential development with conservation goals, such as setting aside a portion of the developed property as a conservation area.	Pejchar et al., 2007, Milder and Clark, 2011
Habitat exchanges/species banking	An arrangement where landowners create, maintain, or improve habitat to earn credits that are purchased by another entity to mitigate impacts to habitat on another property.	Fox and Nino-Murcia, 2005, Environmental Defense Fund (EDF), n.d.
Forest or rangeland carbon offsets	Projects that increase carbon sequestration or prevent emissions through changes in forest or rangeland management by a landowner to offset emissions produced by another entity.	de Steiguer, 2008, Galik and Jackson, 2009
Grassbanking	A tool where forage (i.e., grass) is exchanged on one property for conservation benefits on a neighboring property.	Gripne, 2005, White and Conley, 2007
Pop-up habitats	Landowners are paid to implement a short-term conservation practice only during a period when that practice is needed (e.g., flooding fields during a critical bird migration period).	Jenkins, 2014, Reynolds et al., 2017, Golet et al., 2018

sample. Although we acknowledge the limitations of our approach, we feel our sample captured most of the relevant types of organizations and agencies involved with private lands conservation in the United States.

Before implementing the survey, we completed two rounds of pretesting with qualified conservation practitioners ($n = 18$) to ensure that our questions were clear to respondents. We also included a screening question in the survey asking respondents to confirm that they worked on conservation projects primarily on private lands. The development and implementation of the survey was informed by the tailored design method (Dillman et al., 2014). Following these guidelines, we emailed an initial invitation to participate in the survey followed by four reminders over a six week period between May and July 2016. We varied the message and subject line for each reminder and sent reminders in the morning. The survey and administration procedures were approved for use with human subjects prior to implementation by Colorado State University's Institutional Review Board (Protocol 054-17H).

We aimed to have complete responses for roughly 400 practitioners, which would allow us to generalize to an infinitely large population at a 95% confidence level with a ± 5% margin of error (Vaske, 2008). The final web survey was sent to 1169 valid email addresses and 401 individuals responded. Twenty respondents were screened out and prevented from taking the survey since they did not fit our criteria for inclusion, and 50 respondents did not complete the majority of the survey. Thus we received complete or mostly complete questionnaires from 331 individuals for a response rate of 29%, allowing us to generalize to the population level with a ± 5.4% margin of error (Creative Research Systems (CRS), n.d.). Our response rate is in line with similar online surveys (e.g., Sheehan, 2001; Archie et al., 2012).

In the survey, respondents were given the definition for each tool (Table 1), asked about their familiarity with the tool on a five point Likert scale (0 = “Not at all familiar”, 1 = “Somewhat familiar”, 2 = “Familiar”, 3 = “Very familiar”, and 4 = “Extremely familiar”), and asked to estimate the number of projects they have worked on that incorporated the tool. Respondents who reported being “Familiar”, “Very Familiar”, or “Extremely familiar” with the tool were then asked a series of questions about the effectiveness of the tool at meeting various conservation challenges and the tool's suitability in different landscape contexts. Respondents were also asked about their interest in learning more about the conservation tools, their preferred ways to learn, and to provide information about the type of organization they work for and their experience in the conservation field.

We used analysis of variance (ANOVA) to test for differences in familiarity for each tool among respondents working for the six organizational and agency categories (i.e., local NGOs, state or regional NGOs, national or international NGOs, local government, state government, and federal government). When a significant difference was observed, we used Scheffe's post-hoc tests to identify significant differences among pairwise combinations. We also report eta (η) values and use Cohen's (1988) interpretation criteria (i.e., small, medium, and large) of effect sizes.

To examine differences in conservation practitioners' familiarity, perceived effectiveness and perceived suitability, across the seven tools, we ran linear mixed models with a random effect (Pinheiro et al., 2018) using the package ‘nlme’ in program R (R Core Team, 2018). To compare conservation practitioners' familiarity among the seven tools, our response variable was the familiarity score and the independent categorical variable was the conservation tool. Since this model used multiple responses from the same individual (e.g., familiarity with conservation easements, familiarity with direct payment programs, etc.), we included a random effect for each respondent. We used similar analyses to examine perceived effectiveness and suitability, where the perceived effectiveness or suitability score was the response variable, the conservation tool was the independent variable, and the individual respondent was included as a random effect. Our goal with these analyses was to compare perceptions of effectiveness and suitability among the tools to learn from the experiential knowledge of practitioners about the best uses for the tools, rather than to compare perceptions of individual tools among the different types of conservation practitioners. For all models, we used conservation easements as the intercept and coefficients for the other tools are relative to the intercept. Post-hoc pairwise comparisons among coefficients were made using the package and function ‘emmeans’ following Bonferroni correction for multiple comparisons (Lenth et al., 2018).

Due to the dispersed nature of the study population, we were unable to compare participant characteristics to demographic data of the population (e.g., census data) to evaluate nonresponse bias. As an alternative, we used the first and last 20% to compare answers from early and late survey responders. We used paired *t*-tests to compare familiarity with the seven conservation tools and years of experience in the conservation field, and found no significant differences at the $p < 0.01$ level for any variables tested.

3. Results

Respondents reported high levels of educational attainment and experience in the field. Nearly all of the respondents held a bachelor's degree or higher (98%). Over half (54%) held an advanced degree with 47% reporting a master's degree. A bachelor's degree was the highest level of degree obtained for 44% of respondents. The average number of years of experience in the conservation field was 16.5 and ranged from one year of experience to 50. At the time of the survey, roughly half of respondents worked for a governmental agency (54%) while the other half worked for an NGO (46%). A summary of respondent characteristics is provided in Appendix Table 1.

In comparing familiarity with individual tools among conservation practitioners working for the six categories of organizations, we observed significant differences in ANOVA tests for conservation easements, direct payment programs, and conservation developments (Appendix Table 2). For conservation easements, the difference in familiarity among practitioner types was medium to large ($F = 7.43$, $p < 0.001$, $\eta = 0.33$) with greater familiarity among local NGOs than state ($p < 0.001$) and federal government agencies ($p < 0.01$). For direct payment programs, the difference was also significant and large ($F = 27.54$, $p < 0.001$, $\eta = 0.55$), with local governments statistically less familiar ($p < 0.001$) than all other organizational categories except local NGOs. Local NGOs were also less familiar ($p < 0.001$) with direct payment programs than state and federal government agencies. Finally, we also observed medium to large significant differences in familiarity with conservation developments ($F = 6.15$, $p < 0.001$, $\eta = 0.30$) with greater familiarity among local government and local NGOs than state government agencies.

In comparing across the tools using linear mixed models, conservation practitioners reported a strong familiarity with two conservation tools, conservation easements and direct payment programs. Familiarity with the other five tools was below the mid-point value (Fig. 1). Practitioners were significantly more familiar with conservation easements than all the other tools and more familiar with direct payment programs than the other tools except conservation easements. In contrast, there was no statistical difference in familiarity between conservation developments and habitat exchanges/species banking, habitat exchanges/species banking and forest and rangeland carbon offsets, and grassbanking and pop-up habitats (Fig. 1, Appendix Table 3).

Participants perceived differences in effectiveness at meeting conservation challenges among the tools. Some conservation tools were perceived as particularly effective at meeting several challenges, but not very effective at others (Fig. 2). For example, conservation easements were perceived as most effective for limiting development and keeping land in the family, but less effective at controlling invasive species and restoring ecological processes. Other tools such as grassbanking, habitat exchanges/species banking, and direct payment programs were perceived as the most effective at controlling invasive

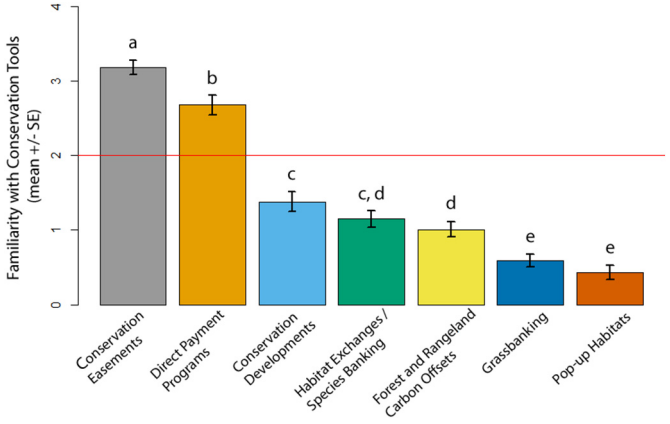

Fig. 1. Conservation practitioners' mean familiarity with seven private lands conservation tools (0 = Not at all familiar, 1 = Slightly familiar, 2 = Familiar, 3 = Very familiar, 4 = Extremely familiar). Conservation tools with different lowercase letters above bars indicate significant differences at the $p < 0.001$ level based on post-hoc pairwise comparisons of coefficients following Bonferroni correction. Solid line represents the mid-point value.

species, restoring ecological processes, and restoring degraded habitat. Notably, only one of the seven tools was perceived as effective (i.e. above the mid-point value) at addressing four of the challenges (Fig. 2). There were significant differences among the tools in the linear mixed models for all eight conservation challenges (Fig. 2, Appendix Table 3).

Significant differences in the perceived suitability of the tools in different landscape contexts also emerged from the linear mixed models. Along an urban to rural gradient, conservation development was the only tool perceived to be well-suited in urban areas and scoring above the mid-point value, but also scored the lowest in rural settings (Appendix Fig. 1, Appendix Table 3). Respondents reported opposite patterns for the other tools, which were perceived to be less well suited to urban environments than rural areas. We also considered the suitability of tools in areas with varying land values ranging from inexpensive to expensive relative to the region, but did not identify meaningful variation among the tools (Appendix Fig. 2).

Roughly two-thirds (67%) of respondents expressed interest in learning more about the conservation tools included in the survey. Among these respondents, there was greatest interest in habitat exchanges/species banking followed by forest and rangeland carbon offsets and grassbanking (Fig. 3), three of the four least familiar tools. Surprisingly, only 42% of respondents were interested in learning more about pop-up habitats, the least familiar tool. Unsurprisingly, participants were least interested in learning more about direct payment programs and conservation easements, the most familiar tools. Websites were the most preferred way to learn about conservation tools with 91% of respondents reporting being "interested", "very interested", or "extremely interested" in this method of professional development. This was followed by online videos (82%) and short briefing papers (81%). Social media, books, and peer-reviewed journal articles were the least preferred ways to learn about conservation tools with 41%, 57%, and 69%, respectively, of respondents reporting being "interested", "very interested", or "extremely interested" in these forms of communication (Appendix Fig. 3).

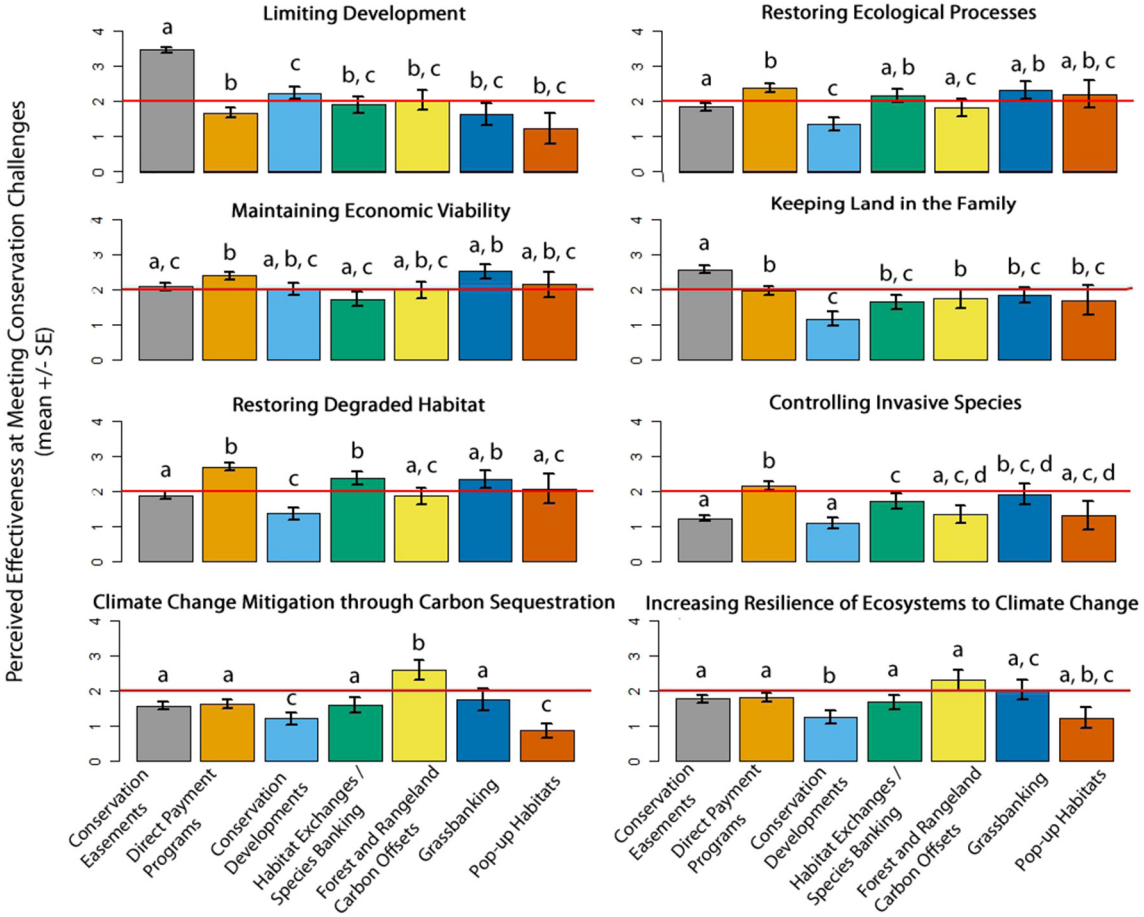

Fig. 2. Perceived effectiveness of different conservation tools at addressing a variety of conservation challenges (0 = Not at all effective, 1 = Slightly effective, 2 = Effective, 3 = Very Effective, 4 = Extremely effective). Conservation tools with different lowercase letters above bars indicate significant differences at the $p < 0.001$ level based on post-hoc pairwise comparisons of coefficients following Bonferroni correction. Solid line represents the mid-point value.

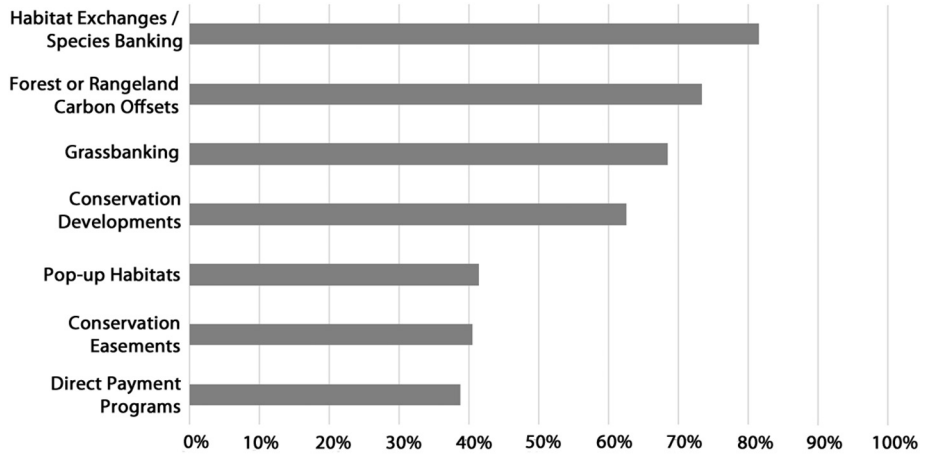

Fig. 3. Percentage of conservation practitioners interested in learning more about the seven conservation tools.

4. Discussion

Conservation of private lands is critical to sustaining biodiversity globally (Knight, 1999; Norton, 2000; Kamal et al., 2015), and a skilled workforce of conservation professionals is needed to support landowner livelihoods and achieve conservation objectives. In our nation-wide survey of conservation practitioners, we found that conservation practitioners have deep knowledge and experience with conservation easements and direct payment programs. Despite familiarity with these two approaches, there was limited knowledge of a broader portfolio of tools and existing experience was relatively concentrated among different types of organizations. Conservation practitioners also recognized that tools were not equally effective at meeting conservation challenges or suitable in different landscape contexts. The concentration of practitioner knowledge on just two primary approaches raises important questions about the potential to meet multiple conservation goals on diverse private lands and adapt to social and ecological change.

Observed differences in familiarity with conservation easements, direct payment programs, and conservation developments among the organizational and agency groups were not unexpected. The land trust movement within the USA has fostered many local land trusts throughout the country that use conservation easements as a primary tool. Most of the direct payment programs in the country are largely implemented by staff at federal and state agencies. Conservation developments are primarily driven by local land-use policies (e.g., county and municipal policies), so it is logical that practitioners working for local NGOs and local governments were more familiar with this tool. These results also suggest specific types of organizations and agencies specialize in a limited number of tools while the broader portfolio of tools is unfamiliar across groups.

It is likely that conservation practitioners' high familiarity with conservation easements and direct payment programs is due in part to the significant funding dedicated to these tools. The conservation title of the 2014 U.S. Farm Bill allocated roughly $26 billion over five years to conservation efforts including conservation easement and direct payment programs. The federal government and several states also provide tax incentives for donations of conservation easements. Yet, these programs are dependent on specific policies and administrative processes that make them vulnerable to political changes. Programs dependent upon funding from state or federal budgets, such as Farm Bill conservation programs (e.g., Conservation Reserve Program), can be particularly susceptible to changing administrations and budget shortfalls. Administrative changes can also jeopardize conservation efforts. The U.S. Internal Revenue Service's investigation of potential abuses of conservation easement tax benefits raised significant concern in the land trust community about losing one of the main financial incentives for this commonly used tool (Stephens, 2005). Similarly, the State of Colorado has experienced a substantial backlog in approvals of conservation easement appraisals for its transferable tax credit program due to administrative changes in the Colorado Division of Real Estate in response to previous abuses of the program (Migoya, 2016). These changes have resulted in a small fraction of conservation easement projects in 2015 and 2016 compared to previous years. A more diverse toolbox that relies on a mix of funding sources and administrative processes is likely to make conservation efforts more resilient to political or institutional changes (Doremus, 2003). For instance, conservation developments are more closely linked to local land-use policies, which helps insulate them from policy changes at the federal or state levels.

Sharing experiential knowledge of a portfolio of conservation tools can help practitioners understand which tools are likely to achieve desired outcomes in response to different conservation challenges and landscape contexts. By considering the specific conservation challenges

Table 2
Summary of perceived effectiveness and suitability of conservation tools (challenge and context included when above mid-point value).

Conservation tool	Most effective at addressing these conservation challenges	Best suited to these landscape contexts
Conservation easements	Limiting development; keeping land in the family	Exurban; rural
Direct payment programs	Restoring ecological processes; maintaining economic viability; restoring degraded habitat; controlling invasive species	Exurban; rural
Conservation developments	Limiting development	Urban; exurban
Habitat exchanges/species banking	Restoring ecological processes; restoring degraded habitat	Rural
Forest or rangeland carbon offsets	Mitigating climate change through carbon sequestration; increasing the resilience of ecosystems to climate change	Rural
Grassbanking	Restoring ecological processes; maintaining economic viability; restoring degraded habitat	Rural
Pop-up habitats	Restoring ecological processes; maintaining economic viability	rural

that need to be addressed and the characteristics of the landscape they are working in, practitioners can tailor an appropriate conservation strategy (Table 2). For instance, while conservation easements and direct payment programs were perceived as effective at limiting development and restoring degraded habitat, they were not perceived as effective at mitigating climate change through carbon sequestration, increasing the resilience of ecosystems to climate change, or as applicable to urban environments. Indeed, most of the conservation tools we considered were reported as most suitable in exurban or rural contexts despite growing awareness of the importance of conserving urban open space in a world where more than half of the population globally lives in cities (Dearborn and Kark, 2010). An expanded portfolio of tools beyond what we assessed in this study may be needed to address complex challenges in rapidly changing environments. For instance, for four of the eight conservation challenges we assessed, only one of the seven tools was perceived as effective (i.e. above the midpoint value) at addressing the challenge and the effective tool depended on the specific challenge (Fig. 2).

We note that the findings related to the tools' effectiveness and suitability are based on respondents' perceptions and experiential knowledge, rather than empirical examination of conservation outcomes. Just as there have been multiple calls for more systematic investigation of conservation easements (Merenlender et al., 2004; Kiesecker et al., 2007; Rissman and Sayre, 2012), we emphasize the need to examine the social and ecological outcomes of a broad suite of private lands conservation tools. Our findings on practitioner perceptions and previous experiences can serve as logical hypotheses to guide this effort and sharing experiential knowledge on a broad set of tools can enhance peer learning among conservation practitioners (Bennett, 2016).

Several of our findings are consistent with the limited number of studies on outcomes. For instance, we found that that practitioners perceive conservation easements as effective at limiting development but not very effective at controlling invasive species. These findings are similar to Pocewicz et al.'s (2011) conclusions that properties with conservation easements in Wyoming had fewer buildings and roads than similar properties without easements, but there were no differences in the presence of invasive species between properties with and without easements. In our study, practitioners perceived pop-up habitats as effective at restoring ecological processes. Similar to our results, Reynolds et al. (2017) found that a pop-up habitat (authors use the term "dynamic conservation") program in the Central Valley of California successfully restored seasonal flooding on participating farms, which resulted in three times the shorebird species richness and five times the shorebird density when compared to non-participating properties. In fact, shorebird densities in participating fields were the largest ever reported on agricultural properties in the region (Golet et al., 2018). In the absence of further empirical studies on outcomes, our findings provide insights on the effectiveness of seven conservation tools in different landscape contexts from the collective experiential knowledge in the private lands conservation community. These perceptions can serve as working hypotheses to focus additional field-based research on conservation outcomes. Additional engagement and synthesis of this knowledge will be necessary to better understand the strengths and limitations of the current portfolio of conservations tools.

We note that the tools considered in this analysis are not necessarily mutually exclusive, but can be used synergistically to maximize conservation benefits on a single property or across property boundaries. For instance, many conservation development projects incorporate conservation easements to restrict development on a portion of the property (Milder and Clark, 2011). Similarly, conservation easements can be used to protect open space of high conservation value, but grassbanking, habitat exchanges, or direct payment programs may also be needed to improve habitat or restore important ecological processes to meet conservation goals for a particular species or ecosystem. Better understanding of how a portfolio of tools can be used in concert to meet complimentary goals can help improve the effectiveness of conservation on private lands. A more diverse portfolio can also make conservation economically viable for landowners by giving them access to incentives associated with different tools (e.g., cash from direct payment programs or habitat exchanges, tax deductions from conservation easements).

Building a portfolio of conservation tools will likely require targeted educational efforts. Some recent innovations, such as pop-up habitats and habitat exchanges, have emerged from larger NGOs such as The Nature Conservancy and the Environmental Defense Fund, respectively, but we did not find evidence that they have diffused to the broader private lands conservation community. We also assume that the broad familiarity with direct payment programs was driven largely by our inclusion of U.S. Farm Bill conservation programs (e.g., Conservation Reserve Program) under the broad category of "direct payment programs" rather than emerging payments for ecosystem services (PES) programs that aim to link conditional payments to well-defined and measured services (Ferraro and Kiss, 2002). Increased knowledge transfer and experimentation with PES efforts in the United States and globally will help conservationists better understand the potential and limitations of these approaches (Ruckelshaus et al., 2015). To expand the professional capacity of conservation practitioners to use a more diverse toolbox and understand how other tools fit with ongoing conservation projects will require outreach efforts tailored to the needs of the community. Our findings suggest there is strong interest among conservation practitioners to learn more about several tools in this study. Developing multiple engagement strategies such as online resources, short briefing papers, workshops, and field visits to project sites, will be necessary to provide learning opportunities that meet conservation practitioners' interests and resources available for professional development.

While our focus in this study is on private lands conservation tools in the US, we feel that the suite of tools we focused on have the potential to be globally relevant. For instance, the grassbanking concept developed in the arid Malpai Borderlands region of Arizona and New Mexico, USA, resembles traditional, communal grazing practices of the Maasai in Kenya (Victurine and Curtin, 2010). Further refinement and adaptation of grassbanking could be informed by the Maasai experience in east Africa. Similarly, the evolution and application of conservation easements in the USA inspired the government of Chile to pass a law creating a similar legal tool for conservation of private lands (Patagonia Sur, n.d.). Costa Rica's pioneering experience making direct payments to landowners to conserve tropical forests has informed similar programs around the world (Pagiola, 2008). Lessons learned from the development of private lands conservation tools in the US should be shared broadly, just as conservationists in the US should look to innovations elsewhere that may help overcome conservation challenges in North America.

Although we believe that a portfolio of tools is needed to achieve multiple conservation goals on diverse private lands, individual tools may not be appropriate in many contexts. Previous research in the USA and other countries has shown that incentive-based conservation approaches can result in negative ecological and socio-economic outcomes in certain situations. For instance, Doherty et al. (2010) argue that species banking and habitat exchanges in the USA are typically based on metrics of habitat impacted and habitat conserved or restored and do not account for underlying population dynamics of the target species. Relying on habitat metrics alone may result in population declines. In a review of market-based approaches to biodiversity conservation in developed countries, Bull et al. (2013) found that many efforts were inconsistent in meeting conservation targets and suffered from challenges in ensuring compliance and effective monitoring. Other work has noted that direct payment (e.g., Payment for Ecosystem Services schemes) and forest carbon offset programs have undermined existing social relations and land tenure arrangements in some places, effectively displacing and marginalizing local resource users (Kosoy and Corbera, 2010; Lyons and Westoby, 2014; Bennett and Gosnell, 2015).

The conservation community should closely monitor tool adoption to better understand the contexts that result in perverse outcomes and those that lead to successful conservation that benefits people and nature.

5. Conclusion

We are encouraged by ongoing efforts to achieve conservation goals on private lands (Kamal et al., 2015; Reynolds et al., 2017). Despite gains in several areas such as the rapid rise in the use of conservation easements since 1990 (Ostlind, 2016), the nature and pace of global change means that greater innovation and investment will be needed to maintain current levels of biodiversity. We find that the US private lands conservation community has a strong foundation of education and experience in the field, yet this foundation is largely based on two principle approaches: conservation easements and direct payment programs. Existing knowledge in the conservation community is also relatively concentrated among practitioners working for particular organizations. There are significant opportunities to enhance the technical capacity of conservation practitioners to implement a broader portfolio of approaches that are likely to be more resilient to social and ecological changes.

Our findings also provide insight into the effectiveness of seven conservation tools in different landscape contexts based on the experiential knowledge of respondents. Respondents viewed some of the tools as particularly effective at meeting several challenges, but not very effective at others. Conservation easements, for instance, were perceived as effective at limiting development and keeping land in the family, but were less effective at addressing other challenges. Only conservation developments were perceived as suitable in urban settings. In the absence of empirical studies on the social and ecological outcomes for many of the tools, findings on practitioner perceptions can serve as working hypotheses for future studies. We view these preliminary findings as a first step towards building a more systematic understanding of the advantages and limitations of the components of a portfolio of conservation approaches on private lands. To address the diverse challenges facing private lands, we recommend practitioners continue to experiment with new approaches while working with the scientific community to evaluate outcomes. The conservation community has a major role to play in determining the future of private lands around the globe; an expanded toolbox will help meet this challenge.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.biocon.2018.09.003.

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